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A Study of Law-Based Chinese Petition System From the Perspective of Evolutionary Game Model

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Abstract

Petition system (named Xinfang in Chinese) is a typical Chinese system for citizens to express opinions and seek non-lawsuit remedies. It was originally positioned with the emphasis on expression of public opinions, but the general public expect more on its rights relief function. Over the recent 30 years, China's economy entered into a period of high-speed development, and the redressal of social interest structure aggregated the conflicts of functional position of petition, which has surged the volume of petition letters and visits. The frequent occurrence of social contradictions resulting from blockage of petitions has seriously impaired social stability. Hence, it is pressing to readjust the functional position of petition and guide the system onto the legal track. In this paper, theoretical analysis is made over the strategy selection and dynamic game of both players of petition during the interaction process by building an evolutionary game model, to conclude an ideal state of stable equilibrium. With the theory base, suggestions are proposed on guiding petition onto the legal track.

Key words: Petition system; Law-based petition; Petition assessment; Irregular petition; Evolutionary game

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INTRODUCTION

Petition system (named “Xinfang” in Chinese or named “letters and visits”) is a typical Chinese system for citizens to express opinions and seek non-lawsuit remedies and it is similar to the Swedish Ombudsman system (Bexelius, 1966), and Japanese complaint system (Deng, 2010). According to the definition given in the *Regulations on Petitions of the State Council of the PRC* (2005), the term “petition” means that citizens, legal persons or other organizations give information, make comments or suggestions or lodge complaints to the people's governments at all levels and the relevant departments of the people's governments at or above the county level through correspondence, E-mails, faxes, phone calls, visits, and so on, which are dealt with by the relevant administrative departments pursuant to law. We can see that, in the Regulations, the petition system is functionally positioned with the emphasis on expression of public opinions, but the general public expect that the emphasis of functional position can be put on rights relief. In its actual operation of petition system, its functions are under the influence of factors including evaluation of government officials' performance and maintenance of social stability. The conflicts of functional position of petition have resulted in the surging volume of petition letters and visits (Wang, 2014). In recent years, in particular, China's reform stepped into the deep-water area, the policies on relocation, environmental protection, and social security, etc., which have to do with the immediate interests of the general public, witnessed constant adjustment, and the structure of social interests was also adjusted. As a result, the problem of petition became more prominent, and relevant interest groups conducted petition visits and haggling complaints time and again by making troubles and organizing demonstrations, and even taking extreme irrational acts or participating in collective social disorder, which occurred once in a

while, such as the collective suicide of petitioners from Sihong of Jiangsu, land expropriation conflict in Jinning of Kunming, taxi strike in Chongqing, and the conflict in Menglian of Yunnan. Once a petition problem is not solved properly, it is easy to give rise to some extreme sudden event, which may impair the normal social order and damage the environment for economic development. How to handle such issues in a proper manner serves as a test for the ruling wisdom and image of the government.

From the perspective of the conducts of both petition players, petition is a conduct game between the government and relevant interest groups. Therefore, in the view of game, this paper investigates the strategy selection and equilibrium of both parties, namely the government and relevant interest groups. In the meantime, through the analysis of the model, proves the feasibility of guiding petition onto the legal track, and puts forward policy suggestions.

1. LITERATURE REVIEW

The development of game theory can be generally divided into three phases: First, from the cooperative game to the non-cooperative game. In the 1950s, the study of cooperative game witnessed flourishing development, and the non-cooperative game also began to appear. Nash (1950, 1951) proposed the concept of “Nash equilibrium” in the *Equilibrium Points in N-person Games* and the *Non-cooperative Games*, starting the study of non-cooperative games. Scholars put forward many non-cooperative static game models, of which the most well-known is the Prisoner’s Dilemma. Second, from the static game to the dynamic game. Selten (1965), introducing dynamic analysis, put forward the idea of refinements of the Nash equilibrium with the concept of (subgame) perfect equilibria and the solving method, a breakthrough in the study of static games. The classic dynamic game models include Stackelberg Model. Third, from the perfect information game to the imperfect information game. Harsanyi (1967-1968) created the theory of imperfect information game. George (1970) built the Lemons Model, pointing out the asymmetric information on commodity quality for buyer and seller, improving the position of imperfect information game theory. Maynard (1974) proposed the “Evolutionarily Stable Strategies”, and Peter & Leo (1978) advanced the concept of “Replicator Dynamics”, which signified the birth of evolutionary game theory, when investigating the ecological evolution phenomena. Based on the step-by-step improvement, the study of game theory has witnessed fast development and formed an independent system.

In recent years, besides economy, the game theory have been extensively applied a great number of other areas including sociology, finance, politics, computer science, and evolutionary biology, etc., achieving great achievements. For instance, Duncan (1948) and Anthony

(1957) put forward the middle voter theorem to study the voting behavior of voters, and Tirole (1986, 1992), a winner of Nobel Economics Prize 2014, investigated the conspiracy of operators and auditors based on the game theory.

The application of game theory in the area of petition also witnessed many valuable fruits in recent years. As the petition system is a typical Chinese phenomenon, the existing literature is mainly written by Chinese scholars. Such literature can be mainly divided into two categories: The first one is characterized by theoretical analysis based on the idea of game. Yu (2009) proposed the “petition paradox”, pointing out that the government falls into a dilemma with regard to the petition system and putting forward suggestions on system reform. Yu (2011) believed that the definition of irregular petition visit is too vague, and this gives game rooms for petitioners and increases the petition control cost. Su (2011), taking the petition of a residential quarter in Shanghai as an example, pointed out the game logic that the government only supports the interest claims of petition groups under some specific conditions. Li (2012) believed that there are three players in the Chinese petition game, petitioner, local government and the state, analyzed the real operation of petition resistance, and revealed that the law is circumvented by implicit rules and civil wisdom, pointing out that the existing petition system is in gave predicament. The second one is characterized by theoretical interpretation based on static game models. Tan et al. (2010) built the game model for land expropriation conflict, analyzing the strategy selection process of landless farmers and local governments. Chen et al. (2012) built a static game model participated by three parties, analyzing the motives and behavior strategy of petitioners by bypassing the immediate authority over internet.

The above studies of petition game are mainly based on China’s actual situation and concentrated on theoretical interpretation and case analysis. Although some analyses are made on the basis of building simple game models, they are all static ones. Therefore, no in-depth study has been made by building a universal model. In the existing literature, the game players are all “economic men” with full rationality, the government only pursues maximum economic benefits, and both game players have completely symmetric access to information. It is self-evident that this is much far from the reality. In fact, the process of petition game is a dynamic one. Governmental departments may take different measures according to a variety of factors such as financial strength, features of petition groups and social influence. Even the same governmental department may take different approaches to a specific petition issue in different stages of petition process. As a petition issue may involve complicated problems, it is hard to reach equilibrium once for all, and it is a prevailing trend that repeated games have to be done. In addition, the petition game process is characterized by imperfect

information and bounded rationality. Due to asymmetry of information, it is hard for petition groups to know the acting strategy of governmental departments, and it is almost impossible for them to predict the payoff matrix of both parties accurately before the game. Moreover, some people follow the others blindly in the process of petition. As a result, the petition groups cannot keep complete rationality. Apparently, it is not reliable to employ a static and completely rational game studying method, with which we can hardly describe the real situation of petition game.

In allusion to existing studies of petition game and particularity of the petition area, this paper believes that petition game is a dynamic process with imperfect information and bounded rationality. We should break through the complete rationality hypothesis and static game model and conduct studies over the interaction between the governmental departments and petition groups in the framework of evolutionary game theory (Larry, 2012) by referring to the dynamic game and evolutionary stable strategy proposed by Taylor and Jonker.

2. BUILDING OF EVOLUTIONARY GAME MODEL

In the process of petition game, many stakeholders gather together for one or more common interest claims and lodge their claims to the government and relevant officials via the regular petition channels. When the interest claims cannot be satisfied, the core members in the group may organize and instigate more people to impose pressure to the government in a more drastic manner. In the process of game, the government may be “enlightened” sometimes and take some legal means to handle the petition issues. Sometimes, the government would, in consideration of stability or under pressure from all parties, take some people-based measures with low cost and fast effect. For instance, there would be some circumstances of “buying stability with money” and “bribing” petitioners. The ideal state is: The government maintains positive interactions with the general public. Relevant stakeholders express their claims rationally via regular petition channels while the governmental departments take normalized legal means to learn the opinions of people, alleviate resentment of people and relieve worries of people. Thus, in combination with the rule of petition and actuality of petition progress, the following hypotheses are put forward.

2.1 Basic Hypotheses

Hypothesis 1: There are two game players with bounded rationality: Governmental department A and petition group B. In the process of evolutionary game, the governmental department and the petition group conduct repeated games.

Hypothesis 2: Governmental department A has two strategy options, “legal petition” and “people-based

petition”. Petition group B has two strategy options, “regular petition” and “irregular petition”. The strategy of “legal petition” means that the governmental department controls the petitions issues according to law and handle such issues in accordance with laws and regulations strictly. It will not give more or less compensation due to the behavior and emotion of petitioners, and will impose punishment against the irrational extreme behaviors of petitioners. Of course, the implementation of legal petition requires paying certain “cost of normalization”, which mainly refers to the time cost and economic cost for preparing relevant legal documents. For instance, the current petition ending system¹ is a kind of method for “legal petition”. In practice, moreover, the superior government will remove those petition cases to which an end has been put in the assessment of “irregular petition” volume. The “people-based petition” strategy means that the government handles petition issues based on experience and authority. Despite its randomness, it is characterized by fast rate and low cost, and no additional “cost of normalization” is required. Under the model of “people-based petition”, the government may, considering the social stability, give additional economic compensation sometimes, with a view to appeasing the agitated petition groups with out-of-line behaviors. The “regular petition” strategy means that the petition groups express their claims rationally via regular petition channels under laws and regulations. The “irregular petition” means that the petition groups impose pressure to the government until reaching their aims (Chen, 2014) resorting to repeated petition, petition by bypassing the immediate authority, petition visits and haggling complaints time and again by making troubles, and irregular petition visit to Beijing, complaint to foreign authority, and participation in collective social disorder.

Hypothesis 2: The two game players have asymmetric accesses to information, namely imperfect information game. Due to the influence of a variety of factors, such as human and material resources, financial strength and identification of government officers to legal petition, the government chooses either the “legal petition” or “people-based petition” strategy at certain probability. According to the situation and different claims of each petition group, the petition is inclined to choose the “regular petition” or “irregular petition” strategy. Therefore, suppose the probability for the government to choose the “legal petition” strategy is x , and that to choose the “people-based petition” strategy is $1-x$; the ratio of petition groups to choose the “regular petition” strategy is y , and that to choose the “irregular petition” strategy is $1-y$.

¹ Petition ending system means that, where, after an issue, which meets the requirements for petition reception, is handled through legal procedure, the petitioner, who should stop making petition visits, still continue his or her petition visit, the special authority will check the petition issue and give a resolution to end the petition.

2.2 Building of Replicator Dynamic Equation

The interaction between the two petition parties is a dynamic process, and the governmental department and petition group conduct games under an uncertain circumstance with bounded rationality. Besides mutual influence, their strategies are also under the influence of game strategies of similar groups and the last game

strategy of the group. Similar to the process of organic evolution, their respective strategies can be inherited, learned and adjusted dynamically. Based on the above three hypotheses, the meanings of major indexes and parameters involved in the process of game are listed as below (Table 1) and a payoff matrix is established for both game players (Table 2).

Table 1
Meanings of Major Indexes and Parameters

Parameter	Definition
C	The additional “cost of normalization” paid by “legal petition” compared with “people-based petition”, including time cost and economic cost for preparing relevant legal documents.
Q	The social benefits received by the government if the government chooses “legal petition” and petition groups choose “regular petition”, with both parties maintaining positive interaction. Generally speaking, such social benefits are hard to estimate. So, just suppose that Q is a relatively stable constant in a short period, and the governmental authorities cannot change Q quickly through short-term strategies. With the accelerated process of a rule-of-law society, people have a deeper understanding to positive interaction, and then Q will increase gradually.
R	The cost needed to pay in settling petition claims, namely the normal benefits received by the petition group; when $R>0$, the claims are reasonable or partially reasonable, and when $R<0$, the claims are not reasonable.
T	Additional economic compensations given to an “irregular petition” group in consideration of social stability when the government chooses “people-based petition”.
P	The punishment imposed on irregular petition acts when the government chooses “legal petition”, which are generally disciplinary warning and administrative detention.
D	The additional cost paid with “regular petition” compared with “irregular petition” when a petition group bring the government to attach importance to relevant petition issues, including the time and economic cost in waiting the handing of petition issue. Generally speaking, the handing period for “regular petition” is 60 days, but for “irregular petition”, relevant issues will be handled quickly as special cases.
F	Assessment conducted by a superior government to a subordinate government regarding the irregular petition acts due to “people-based” strategies within the latter’s jurisdiction.
K	Assessment conducted by a superior government to a subordinate government regarding the irregular petition acts due to “legal” strategies within the latter’s jurisdiction. In current practice, some regions have abated irregular petition acts due to “legal” strategies in assessment. For instance, Shanghai Municipality does not cover the irregular petition visits of petitioners to Beijing, which have gone through the petition ending procedure. Therefore, it is common to have $K<F$.

Table 2
Game Payoff Matrix Between Governmental Departments and Petition Groups

		Petition group B	
		Regular group (y)	irregular group ($I-y$)
Governmental Department A	Legal petition (x)	$Q-R-C, R-D$	$-R-C-K, R-P$
	People-based petition ($I-x$)	$-R, R-D$	$-R-T-F, R+T$

For governmental department A , the expected benefits to choose “legal petition” and “people-based petition” are respectively U_{A1} and U_{A2} , and average expected benefits to choose the strategy of combining “legal petition” and “people-based petition” is \bar{U}_A . Then, we have

$$U_{A1} = y(Q - R - C) + (1 - y)(-R - C - K) \quad (1)$$

$$U_{A2} = y(-R) + (1 - y)(-R - T - F) \quad (2)$$

$$\bar{U}_A = xU_{A1} + (1 - x)U_{A2} \quad (3)$$

The replicator dynamic equation of strategy of the governmental department:

$$F(x) = \frac{dx}{dt} = x(U_{A1} - \bar{U}_A) = x(1 - x)[(Q + K - F - T)y + F + T - C - K] \quad (4)$$

$$F'(x) = (1 - 2x)[(Q + K - F - T)y + F + T - C - K] \quad (5)$$

In like manner, we can obtain the average expected benefits of strategy of the credit group and its replicator dynamic equation:

$$U_{B1} = x(R - D) + (1 - x)(R - D) \quad (6)$$

$$U_{B2} = x(R - P) + (1 - x)(R + T) \quad (7)$$

$$\bar{U}_B = yU_{B1} + (1 - y)U_{B2} \quad (8)$$

$$F(y) = \frac{dy}{dt} = y(U_{B1} - \bar{U}_B) = y(1 - y)[(P + T)x - D - T] \quad (9)$$

$$F'(y) = (1 - 2y)[(P + T)x - D - T] \quad (10)$$

3. ANALYSIS OF EVOLUTIONARY GAME BETWEEN GOVERNMENTAL DEPARTMENTS AND PETITION GROUPS

3.1 Evolutionary Game Strategies of Governmental Departments

(a) In the case of $F - K + T = Q$, namely, this is a special circumstance, the summation of the difference in the punishments imposed by the superior government based on assessment of irregular petition acts under “people-based” and “legal” strategies with the additional compensation to irregular petition acts under strategy of “people-based petition” equals to the social benefits received by the government under positive interaction between both parties.

Then, x is always tenable, namely x remains at the stable level in all cases. The practical interpretation is: no matter the petition groups are inclined to “regular petition” or “irregular petition” in any ratio, the benefits received by the governmental departments in choosing “legal petition” and “people-based petition” are the same. That is to say, x is always the stable state of governmental departments in all cases.

(b) In the case of $F - K + T > Q$, namely the summation of the difference in the punishments imposed by the superior government based on assessment of irregular petition acts under “people-based” and “legal” strategies with the additional compensation to irregular petition acts under strategy of “people-based petition” is larger than the social benefits received by the government under positive interaction between both parties. The practical interpretation for the circumstance is: in the early period of law-based petition, people only have a limited understanding to positive social interaction, and Q remains at a relatively low level.

Then, suppose $F(x) = 0$, we can get $x^* = 0$ or $x^* = 1$ or $y^* = \frac{(F + T - C - K)}{(F + T - Q - K)}$.

a) In the case of $y = y^*$, then $F(x) = 0$ is always tenable, namely x remains at the stable level in all cases. The practical interpretation is: when the petition groups choose “regular petition” in the ratio of y^* , the benefits received by the governmental departments in choosing “legal petition” and “people-based petition” are the same. That is to say, x is always the stable state of governmental departments in all cases.

b) In the case of $y < y^*$, then $x^* = 0$ and $x^* = 1$ are two possible stable points of x . If $F'(1) < 0$, then $x^* = 1$ is the evolutionary stable strategy. The practical interpretation is: when the petition groups choose “regular petition” in the ratio below y^* , the strategy of governmental departments transfer from “people-based petition” to “legal petition” gradually. That is to say, “legal petition” is the evolutionary stable strategy of governmental departments.

c) In the case of $y > y^*$, then $x^* = 0$ and $x^* = 1$ are two possible stable points of x . If $F'(0) < 0$, $x^* = 0$ is the evolutionary stable strategy. The practical interpretation is: when the petition groups choose “regular petition” in the ratio higher than y^* , the strategy of governmental departments transfer from “legal petition” to “people-based petition” gradually. That is to say, “people-based petition” is the evolutionary stable strategy of governmental departments.

(3) In the case of $F - K + T < Q$, namely the summation of the difference in the punishments imposed by the superior government based on assessment of irregular petition acts under “people-based” and “legal” strategies with the additional compensation to irregular petition acts under strategy of “people-based petition” is smaller than the social benefits received by the government under positive interaction between both parties. The practical interpretation for the circumstance is: in the late period of law-based petition, people have a deeper understanding to positive social interaction, and Q will increase continuously, reaching a high level.

Then, suppose $F(x) = 0$, we can get $x^* = 0$ or $x^* = 1$ or $y^* = \frac{(F + T - C - K)}{(F + T - Q - K)}$.

a) In the case of $y = y^*$, then $F(x) = 0$ is always tenable, namely x remains at the stable level in all cases. The practical interpretation is: when the petition groups choose “regular petition” in the ratio of y^* , the benefits received by the governmental departments in choosing “legal petition” and “people-based petition” are the same. That is to say, x is always the stable state of governmental departments in all cases.

b) In the case of $y < y^*$, then $x^* = 0$ and $x^* = 1$ are two possible stable points of x . If $F'(0) < 0$, then $x^* = 0$ is the evolutionary stable strategy. The practical interpretation is: When the petition groups choose “regular petition” in the ratio below y^* , the strategy of governmental departments transfer from “legal petition” to “people-based petition” gradually. That is to say, “people-based petition” is the evolutionary stable strategy of governmental departments.

c) In the case of $y > y^*$, then $x^* = 0$ and $x^* = 1$ are two possible stable points of x . If $F'(1) < 0$, $x^* = 0$ is the evolutionary stable strategy. The practical interpretation is: when the petition groups choose “regular petition” in the ratio higher than y^* , the strategy of governmental departments transfer from “people-based petition” to “legal petition” gradually. That is to say, “legal petition” is the evolutionary stable strategy of governmental departments.

3.2 Evolutionary Game Strategies of Petition Groups

Suppose $F(y) = 0$, we can get $y^* = 0$ or $y^* = 1$ or $x^* = \frac{D + T}{P + T}$.

a) In the case of $y = x^*$, then $F(y) = 0$ is always tenable, namely y remains at the stable level in all cases.

The practical interpretation is: when the governmental departments choose “legal petition” in the ratio of x^* , the benefits received by the petition groups in choosing “regular petition” and “irregular petition” are the same. That is to say, y is always the stable state of governmental departments in all cases.

b) In the case of $x < x^*$, then $y^* = 0$ and $y^* = 1$ are two possible stable points of x . If $F'(0) < 0$, $y^* = 0$ is the evolutionary stable strategy. The practical interpretation is: when the governmental departments choose “legal petition” in the ratio lower than x^* , the strategy of petition groups transfer from “regular petition” to “irregular petition” gradually. That is to say, “irregular petition” is the evolutionary stable strategy of petition groups.

c) In the case of $x > x^*$, then $y^* = 0$ and $y^* = 1$ are two possible stable points of x . If $F'(1) < 0$, $y^* = 1$ is the evolutionary stable strategy. The practical interpretation is: When the governmental departments choose “legal petition” in the ratio higher than x^* , the strategy of petition groups transfer from “irregular petition” to “regular petition” gradually. That is to say, “regular petition” is the evolutionary stable strategy of petition groups.

3.3 Evolutionarily Stable Strategies of Governmental Departments and Petition Groups

The evolutionary game between governmental departments and petition groups can be described with the system comprised of equations (4) and (9). As the circumstance of “ $F-K+T=Q$ ” is only an exceptional case in reality and it cannot constitute an evolutionary system, we only discuss the other two circumstance here.

(a) In the early period of law-based petition (namely $F-K+T>Q$), the governmental departments only have a limited understanding (Q is small) to the social benefits brought by the positive interaction between both parties. If

and only if $0 \leq x^* \leq 1$ and $0 \leq y^* \leq 1$ are tenable, an evolutionary game system exists. Then, we have $P > D$, $C > Q$, and $F-K+T > C$ in reality. The practical interpretation is: the regular petition cost, namely the economic and time cost of petition D , is very small, far smaller than the punishment suffered due to irregular petition. In the early period of law-based petition, we can take C as the legal cost, and Q the legal benefits, and legal unit cost is higher than the unit benefit. Meanwhile, the legal cost C is smaller than the summation of difference ($F-K$) in assessments of irregular petition data under people-based and legal petition strategies with additional compensation (T) to petition groups. Otherwise, there would be no power driving petition onto the legal track. Then, there may be 5 equilibrium points in the system. Specifically, $E_1(0, 0)$ signifies that the governmental departments all choose the “people-based petition” strategies, and the petition groups all choose the “irregular petition” strategies; $E_2(1, 0)$ signifies that the governmental departments all choose the “legal petition” strategies, and the petition groups all choose the “irregular petition” strategies; $E_3(0, 1)$ signifies that the governmental departments all choose the “people-based petition” strategies, and the petition groups all choose the “regular petition” strategies; $E_4(1, 1)$ signifies that the governmental departments all choose the “legal petition” strategies, and the petition groups all choose the “regular petition” strategies; $E_5(x^*, y^*)$ signifies that the governmental departments choose the “legal petition” strategies in the probability of x^* , and the petition groups all choose the “regular petition” strategies in the probability of y^* . Based on the Jacobian matrix method of Daniel (1991), a group dynamics described in differential equation, the stability of its equilibrium points can be got through the local stability of the system’s Jacobian matrix. Thus, the Jacobian matrix of the system is:

$$J = \begin{bmatrix} \frac{\partial F(x)}{\partial x} & \frac{\partial F(x)}{\partial y} \\ \frac{\partial F(y)}{\partial x} & \frac{\partial F(y)}{\partial y} \end{bmatrix} = \begin{bmatrix} (2x-1)(C-F+K-T+Fy-Ky-Qy+Ty) & x(x-1)(F-K-Q+T) \\ -y(P+T)(y-1) & (2y-1)(D+T-Px-Tx) \end{bmatrix} \quad (11)$$

From equation (11), we can know that the determinant of matrix J is:

$$\det J = \frac{\partial F(x)}{\partial x} \cdot \frac{\partial F(y)}{\partial y} - \frac{\partial F(x)}{\partial y} \cdot \frac{\partial F(y)}{\partial x} = (2x-1)(2y-1)(C-F+K-T+Fy-Ky-Qy+Ty)(D+T-Px-Tx) + xy(x-1)(y-1)(F-K-Q+T)(P+T). \quad (12)$$

The track of matrix J is:

$$\text{tr } J = \frac{\partial F(x)}{\partial x} + \frac{\partial F(y)}{\partial y} = (2x-1)(C-F+K-T+Fy-Ky-Qy+Ty) + (2y-1)(D+T-Px-Tx). \quad (13)$$

With the above method, if and only if , the system has stable equilibrium points. Based on the result of Table 3,

the system does not have stable equilibrium points.

Table 3
Analysis Result of Jacobian Matrix ($F-K+T>Q$)

Possible equilibrium point	det J		tr J		Result
	Value	Symbol	Value	Symbol	
$E_1(0, 0)$	$-(D+T)(F-K-C+T)$	-	$F-K-D-C$	TBD	Unstable
$E_2(1, 0)$	$(D-P)(F-K-C+T)$	-	$C-D-F-K+P-T$	TBD	Unstable
$E_3(0, 1)$	$-(C-Q)(D+T)$	-	$D-C+Q+T$	TBD	Unstable
$E_4(1, 1)$	$(C-Q)(D-P)$	-	$C+D-P-Q$	TBD	Unstable
$E_5(x^*, y^*)$	$\frac{(C-Q)(P-D)(D+T)(F-K-C+T)}{(P+T)(F-K-Q+T)}$	+	0		Saddle point

To sum up the strategies chosen by the governmental departments and petition groups under the above different circumstances and stability analysis of all equilibrium points, we can get the duplicator dynamic process (see Figure 1a) and the strategy profile shift (see Figure 1b) of evolutionary game. It can be seen that, in the game in the early period of law-based petition, the interaction process track involving players are related to the initial strategy state closely.

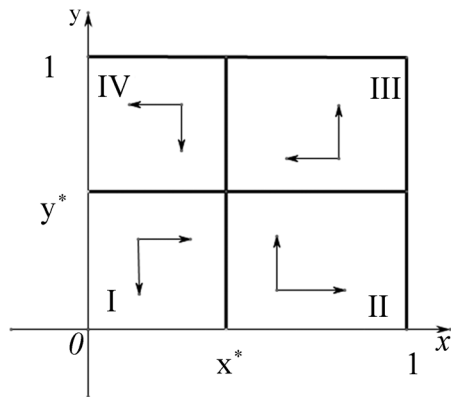


Figure 1a
The Duplicator Dynamic Process Diagram of Evolutionary Game In The Early Period of Law-Based Petition

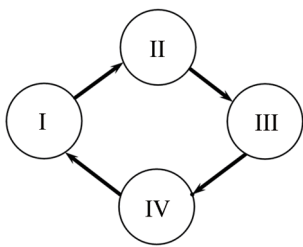


Figure 1b
The Strategy Profile Shift Diagram of Evolutionary Game in the Early Period of Law-Based Petition

According to Fig. 1a and 1b, in the early period of law-based petition progress, there is not a stable equilibrium state in the game between both parties, but it is a cycle going round and round ($I \rightarrow II \rightarrow III \rightarrow IV \rightarrow I$).

a) When the initial strategy is in Domain I, $x < x^*$, $y < y^*$, and $x=1$ is the stable strategy of governmental departments, and $y=0$ is the stable strategy of petition groups. Therefore, both parties move along $(1, 0)$ and come into Domain II finally. The practical interpretation is: The governmental departments become increasingly

inclined to “legal petition” while the petition groups become increasingly inclined to “irregular petition”.

b) When the initial strategy is in Domain II, $x > x^*$, $y < y^*$, and $x=1$ is the stable strategy of governmental departments, and $y=1$ is the stable strategy of petition groups. Therefore, both parties move along $(1, 1)$ and come into Domain III finally. The practical interpretation is: The governmental departments become increasingly inclined to “legal petition” while the petition groups become increasingly inclined to “regular petition”.

c) When the initial strategy is in Domain III, $x > x^*$, $y > y^*$, and $x=0$ is the stable strategy of governmental departments, and $y=1$ is the stable strategy of petition groups. Therefore, both parties move along $(0, 1)$ and come into Domain IV finally. The practical interpretation is: the governmental departments become increasingly inclined to “people-based petition” while the petition groups become increasingly inclined to “regular petition”.

d) When the initial strategy is in Domain IV, $x < x^*$, $y > y^*$, and $x=0$ is the stable strategy of governmental departments, and $y=0$ is the stable strategy of petition groups. Therefore, both parties move along $(0, 0)$ and come into Domain I finally. The practical interpretation is: the governmental departments become increasingly inclined to “people-based petition” while the petition groups become increasingly inclined to “irregular petition”.

Based on the above analysis, it can be concluded that II and III are two ideal domains, in which the petition groups become more inclined to choose regular petition and the whole society is in a state of relative harmony and stability as well as positive interaction. We can see that, in the early period of law-based petition, when the point falls within Domain IV, the superior government should intensify the assessment of irregular petition acts due to “people-based” strategy in the jurisdiction of the subordinate government (F increases), and abate the assessment of irregular petition acts due to “legal” strategy (K decreases). Meanwhile, the subordinate government should, considering stability, increase additional compensation to the petition groups (T increases), reduce the “normalization cost” paid for “legal petition” (C decreases), and increase y^* to speed up the strategy profile to move toward Domain I. When the point falls within Domain I, the government should strictly control the additional compensation to petition groups (T decreases), and make great efforts to reduce the cost

of regular petition (D decreases). In addition, it should impose severe punishment to illegal acts in irregular petition (P increases), and decreases x^* to push the strategy profile to ideal Domain II.

(b) In the late period of law-based petition (namely $F-K+T < Q$), governmental departments have a deeper understanding to law-based petition and a higher expectation to the social benefits Q brought by the positive interaction between both parties. If and only if and is tenable, an evolutionary game system exists. Then, we have $P > D$, $C < Q$, and $F-K+T < C$. The practical interpretation is: in the late period of law-based petition,

the cost of regular petition of the general public is still lower than the punishments imposed for irregular petition. The legal strategy gradually brings into play its social benefits, and the unit benefit becomes higher than the unit cost gradually. The government becomes increasingly willing to handle issues with legal ways, and there are a decreasing number of circumstances where the government purchases stability with money (T decreases). Then, the system still has five equilibrium points E_1 - E_5 . In the like manner, according to the Jacobian matrix of Daniel (1991), we can see that the system has two stable equilibrium points E_1 (0, 0) and E_4 (1, 1).

Table 4
Analysis Result of Jacobian Matrix (Namely: $F-K+T < Q$)

Possible equilibrium point	Value	Symbol	Value	Symbol	Result
E_1 (0, 0)	$-(D+T)(F-K-C+T)$	+	$F-K-D-C$	-	Stable
E_2 (1, 0)	$(D-P)(F-K-C+T)$	+	$C-D-F-K+P-T$	+	Unstable
E_3 (0, 1)	$-(C-Q)(D+T)$	+	$D-C+Q+T$	+	Unstable
E_4 (1, 1)	$(C-Q)(D-P)$	+	$C+D-P-Q$	-	Stable
$E_5(x^*, y^*)$	$\frac{(C-Q)(P-D)(D+T)(F-K-C+T)}{(P+T)(F-K-Q+T)}$	-	0		Saddle point

To sum up the strategies chosen by the governmental departments and petition groups under the above different circumstances and stability analysis of all equilibrium points, we can get the duplicator dynamic process (see Figure 2a) and the strategy profile shift (see Figure 2b) of evolutionary game. Likewise, in the game in the late period of law-based petition, the interaction process track involving players are related to the initial strategy state closely and there are two stable equilibrium states.

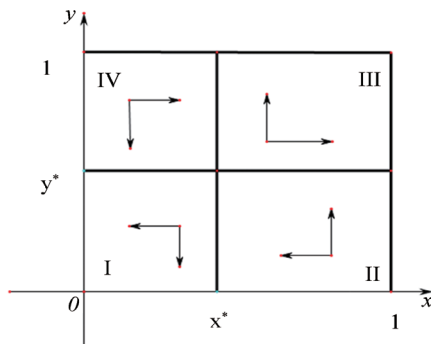


Figure 2a
The Duplicator Dynamic Process Diagram of Evolutionary Game in the Late Period of Law-Based Petition

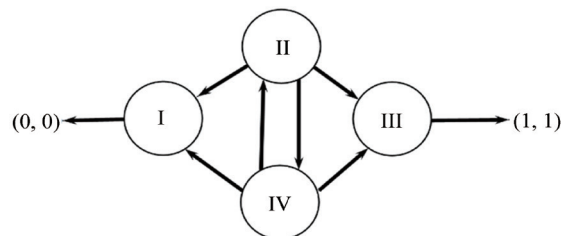


Figure 2b
The Strategy Profile Shift Diagram of Evolutionary Game in the Late Period of Law-Based Petition

According to Figures 2a and 2b, in the late period of law-based petition progress, I and III are the two domains with stable equilibrium states, respectively pointing at E_1 (0, 0) and E_4 (1, 1). In Domain I, the government becomes increasingly inclined to choose “people-based petition” and the petition groups become increasingly inclined to choose “irregular petition”, so obviously it is easy to cause conflicts and it is unfavorable to drive the progress of law-based petition. Thus, it is not an ideal domain. In contrast, in Domain III, the government becomes increasingly inclined to choose “legal petition” and the petition groups become increasingly inclined to choose “regular petition”. Both parties are in positive interaction, which is favorable to drive the progress of law-based petition. Thus, it is an ideal domain. As unstable domains, Domains II and IV are less ideal ones, superior to Domain I but inferior to Domain III. After a period of movement, it is possible for either of them to shift to the other three domains. We can see that, in the late period of law-based petition, when the point falls within Domain II, the superior government should intensify the assessment of irregular petition acts due to “people-based” strategy in the jurisdiction of the subordinate government (F increases), and abate the assessment of irregular petition acts due to “legal” strategy (K decreases). Meanwhile, the subordinate government should, considering stability, increase additional compensation to the petition groups (T increases), reduce the “normalization cost” paid for “legal petition” (C decreases), and decrease y^* to speed up the strategy profile to move toward Domain III. When the point falls within Domain IV, the government should strictly control the additional compensation to petition groups (T decreases), and make great efforts to reduce the cost of regular petition (D decreases). In addition,

it should impose severe punishment to illegal acts in irregular petition (P increases), and decreases x^* to push the strategy profile to move toward ideal Domain III. When the point falls within Domain I, the government will not make adjustment to T , but should intensify the assessment of irregular petition acts due to “people-based” strategy (F increases), abate the assessment under the “legal” strategy (K decreases), impose more severe punishment (P increases), reduce the legal cost of petition (C decreases), lower the cost of regular petition borne by the general public (D decreases), and decrease x^* and y^* to make the strategy profile fall within the other three domains. In general, we hope that Domain IV is large enough while Domain I is as small as possible.

CONCLUSION

The following conclusions are drawn by building an evolutionary game model:

Firstly, the strategy selection of the governmental departments and that of petition groups are influencing each other. In particular, the critical value $y^* = \frac{(F+T-C-K)}{(F+T-Q-K)}$ determines the inclination of the governmental departments in strategy selection, and the critical value $x^* = \frac{(D+T)}{(P+T)}$ determines the inclination of the petition groups in strategy selection.

Secondly, the duplicator dynamic process of evolutionary game of petition varies in different period of law-based petition. In the early period (namely $F-K+T < Q$), the duplicator dynamic process of game between both parties is a cycle going round and round, and the strategy profile shifts in the four domains in turn. In the late period (namely $F-K+T > Q$), the duplicator dynamic process of game between both parties is not a cycle, but there are two stable equilibrium states. In addition, the position of its initial point influences its final state.

Thirdly, the ideal domain also varies in different period of law-based petition. In the early period of legal petition, II and III are two ideal domains. In the late period of law-based petition, III is the most ideal domain, and Domain I exists as an extremely awful domain at the same time.

Fourthly, adjustment of parameters can speed up the movement of system and make the strategy profile reach a relatively ideal domain. The time for adjusting parameters varies in different period of law-based petition. Additionally, the model involves three kinds of parameters: Type 1, for instance F , K , P , C and D , always have the same direction of adjustment. Type 2, for parameter T , needs to be adjusted higher sometimes and lower sometimes. In the long run, in the late period ($F-K+T > Q$), the better the smaller T is. Type 3, for parameter R , will not influence the strategy selection and strategy profile movement of both parties no matter it is 0 or not ($R=0$, the claims are not reasonable; $R>0$, the claims are reasonable to some extent).

ADVICE ON POLICY

In order to push petition onto the legal track and handle petition issues in a better way, the following advice on policy are proposed in consideration of the current petition reality and in combination with the research results of evolutionary game model:

Firstly, guide petition onto the legal track (increase Q). In the early period of law-based petition, the petition game enters into a strange cycle, and there is not an ideal state of stable equilibrium. The government puts emphasis on “legal” strategy now and then, and has to resort to the “people-based” strategy once in a while to “buy stability with money”, appease contradictions and disputes quickly and prevent petition issues from swelling and aggravation. Nevertheless, if the early period lasts too long, it would make the problem of “buying stability with money” become worse, thus damaging the confidence of governmental departments and petition groups to law-based petition. Therefore, the legislature should accelerate the process of legislation for law-based petition and advocate the law-based petition with greater efforts so that the government and the general public can both realize the value expectation produced by positive social interaction. In the late period of law-based petition, the petition game goes out of the strange cycle and two stable equilibrium states come into existence. It is noteworthy that a “trap” (Domain I in Figure 2a) may appear here, and the government and petition groups lose confidence in law-based petition and become inclined to choose “people-based” strategy and “irregular petition” respectively. This indicates that we should, in the process of pushing the law-based petition from the early period to the late period, grasp the opportunity accurately to prevent the initial point from falling into the “trap” and ensure that the petition game can shift toward the only ideal state (Domain III in Figure 2a).

Secondly, improve the petition efficiency (C and D decrease). The government may make petition channels more accessible in a number of ways, such as building an internet petition system, organizing visits to the public and receiving visits via video, so as to guide people to express their claims in a rational way under laws and regulations. We suggest the government to organize survey over the satisfaction of the general public to the government’s works regarding petition, accelerate the handling process of petition issues, reduce the time and financial cost spent by people on regular petition, and elevate the confidence of the general public to solving problems via regular petition channels. The working procedure for “law-based petition” should be refined and simplified to reduce the operation cost of works regarding petition, and more impetus should be given to the governmental department to choose “legal petition”. A petition information system networked nationwide should be established to intensify petition information management so that all petition issues are accessible for inquiry and tracking.

Thirdly, protect the regular petition order under law (P increases). The publicity efforts on Regulations on Petition should be intensified, and lawful regular petition acts and illegal irregular petition acts should be defined accurately. For the few illegal acts organizing and stirring up people to make petition visits and lodge haggling complaints time and again by making troubles, which seriously affect the public order, severe punishment should be imposed without compromise.

Fourthly, normalize the handling of petition issues (control T). The petition issues should be classified carefully. The reasonable and lawful parts must be made up to protect the legal rights and benefits of the general public. For the parts not supported by policies, careful description on relevant policies should be given to the general public to win their understanding. Under some special circumstances, for instance the petitioners are aged and suffer from poor health and hard life, the government should give proper additional subsidies in consideration of fairness, equality and humanitarian. Under other circumstances, the acts of the government to “buy stability with money” without principle or even to bribe petitioners should be controlled strictly.

Fifthly, improve the petition assessment (F increases, and K decreases). It is suggested to abate the assessment of irregular petitions under the “legal” strategy. For example, for the issues that have gone through the petition ending procedure strictly, relevant departments may refuse to accept the petition acts of relevant petition groups according to the principle of court “second instance as the final instance” and such acts will not be covered into assessment. It is suggested to intensify the assessment of irregular petitions under the “people-based” strategy. For governmental departments and officials that fail to perform proper acts, take random acts and formulate unreasonable policies or fail to enforce relevant policies as required, causing people to organize irregular petition, their responsibilities must be investigated, and the responsibility investigation should be intensified. In this way, the progress of law-based petition can be pushed forward in terms of petition assessment.

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